Socioeconomic Factors Affecting Discharge Status of Patients with Uncomplicated Transsphenoidal Adenohypophysectomy

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Abstract

Objectives The number of transsphenoidal adenohypophysectomies (TSAs) surgeries has grown significantly since 1993. While there has been an overall decreasing trend in length of stay (LOS), socioeconomic factors may impact hospitalization. This study explores the impact of socioeconomic factors on LOS and total charges in uncomplicated patients undergoing TSA.

Design Retrospective cohort.

Setting 2009 to 2013 Nationwide Inpatient Sample.

Participants Patients undergoing TSA without medical complications.

Main Outcomes Measures LOS and total charges.

Results A total of 6,457 patients were identified, of which 17.2% had secreting tumors. Patients with secreting tumors stayed 2.95 days versus those with nonsecreting tumors stayed 3.26 days ($p < 0.001$). Discharge to other than self-care was the largest contributing variable for both subsets, increasing both LOS and total charges. Patient factors that drove longer LOS and increased total charges for both subsets included metropolitan domicile, having a lower median income, Hispanic ethnicity, and having an increased amount of Agency for Healthcare Research and Quality (AHRQ) comorbidity indices. Having private insurance predicted a shorter LOS and lower total charges.

Conclusions These results demonstrate that, even without complications, patients can be delayed in their discharge. While several socioeconomic factors significantly predict LOS and charges, the discharge disposition ultimately has the greatest effect. This suggests that efforts should focus on improving organizational factors such as coordination with social work and outside facilities to decrease LOS and charges for this patient population.

Keywords

- pituitary tumor
- transsphenoidal adenohypophysectomy
- socioeconomic factors
- discharge disposition
- hospital length of stay
- hospital total charges

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Introduction

Pituitary tumor diagnoses and resections have grown significantly over the past 20 years, resulting in increased transsphenoidal adenohypophysectomy (TSA).¹ Given an increasing emphasis on practicing cost-effective care, hospitals are reducing hospital length of stay (LOS) while still trying to maintain high quality of care.^{2,3} Ways to reduce LOS after TSA have recently been investigated. There has overall been a decreasing trend in LOS, with several factors implicated. These include endoscope versus microscope use, surgeon experience, hospital caseload, patient age, and medical comorbidities.^{4–9} Despite this overall trend, patients with significant socioeconomic barriers still require longer hospitalization.³

When looking at the effects of socioeconomic factors in patients undergoing TSA, age has been the only factor that has been related to LOS,⁷ and insurance status and race have been the only factors that have been related to total charges.¹⁰ Furthermore, although studies have investigated socioeconomic status's impact on pituitary surgery outcomes, there have been no specific studies independently looking at its impact on LOS and total charges.^{4,11}

This study examines the impact of socioeconomic status, discharge disposition, and hospital characteristics on a patient's hospital stay for patients undergoing TSA without postsurgical complications. The effect of the patient's stay will be evaluated using LOS and total hospital charges accrued by the patient.

Materials and Methods

Database Characteristics

We analyzed discharge data from the Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), and Agency for Healthcare Research and Quality (AHRQ; Rockville, Maryland, United States) from 2009 to 2013. This database represents an approximate 20% stratified sample of U.S. community hospitals. Detailed information on the design of the NIS is available at <http://www.hcup-us.ahrq.gov>.

Inclusion/Exclusion Criteria

Patients undergoing resection of pituitary lesions were identified in the NIS using a combination of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes. Procedures studied include a partial or total resection of the pituitary gland (transsphenoidal approach: 07.62, 07.65; along with one of the following primary diagnosis codes: 227.3 (benign neoplasm of pituitary), 253.2 (panhypopituitarism), 253.8 (pituitary disorder not elsewhere classified [NEC]), 253.4 (anterior pituitary disorder NEC), 253.1 (anterior pituitary hyperfunction NEC), and 253.9 (pituitary disorders not otherwise specified [NOS]). Patients who had multiple resection procedure codes ($n = 84$) were excluded from this study to allow for homogeneity of the cohorts and better comparison between groups. To eliminate the potentially confounding effects on LOS, patients with postoperative complications were excluded from this study using both ICD-9-CM diagnosis codes ($n = 2,518$) and procedure codes ($n = 30$).

These included postoperative systemic complication (997.0–997.9); hematoma complicating a procedure (998.1–998.13); any intracerebral hemorrhagic event (430–432); fluid and electrolyte abnormalities (276.0–9); pulmonary complications including acute respiratory distress syndrome (518.81–85, 997.3); diabetes insipidus (253.5); iatrogenic panhypopituitarism (253.7); diplopia, ptosis, or deficits of cranial nerves 3, 4, or 6 (368.2, 374.2–3, 378.0–9); cerebrospinal fluid (CSF) rhinorrhea (349.81); mechanical ventilation (96.70 – 96.72); deep venous thrombosis, pulmonary embolism, or placement of an inferior vena cava filter (415, 415.11–19, 453.8 – 9, 38.7); epistaxis (784.7); and transfusion of packed red blood cells (99.04). A subset of patients with secretory tumors was extracted utilizing the ICD-9-CM diagnosis codes for Cushing's syndrome (255.0), prolactinoma (253.1), galactorrhea (611.6), and acromegaly (253.0).

Data Characteristics

Patient-specific factors including age, sex, race, payer, location, and income, and hospital-level factors including region, teaching status, bed size, location, and ownership were coded in the NIS data. Individual comorbidity burden was determined using a modified Charlson Comorbidity Index (CCI) based on ICD-9-CM codes.¹² This index is a weighted patient score designed to account for various comorbidities, including history of cancer, as well as cardiac, vascular, pulmonary, neurologic, endocrine, renal, hepatic, gastrointestinal, and immune disorders. Previous studies have demonstrated that slight modifications to the Charlson index have minimal impact on the overall score.^{13,14}

Statistical Analysis

Data were analyzed using SPSS version 22. Categorical variables were compared using chi-square tests. Continuous variables were compared utilizing student's *t*-tests and Mann–Whitney *U*. Generalized linear models were used to analyze economic outcomes (hospital cost and LOS). The analyses considered age, total number of AHRQ comorbidity indices, gender, discharge disposition, primary payer, patient location, median household income, hospital bed size, hospital teaching status, hospital ownership, and hospital region. The exponential parameter estimates were reported as the effect ratio for each variable.

Results

A total of 6,457 admissions for resection of pituitary lesions were identified in the NIS database from 2009 to 2013 and met our inclusion criteria. A total of 1,111 patients (17.2%) had secretory tumors at an average age of 43.9 years ($SD = 14.3$) of age, mean LOS of 2.9 days ($SD = 1.9$), and median total charges of \$43,698.50 (interquartile range [IQR] = \$30,068.50–\$65,910.75). Conversely, the patients with nonsecretory tumors were statistically older at 54.1 years ($SD = 15.5$, $p < 0.001$), stayed statistically longer at 3.3 days ($SD = 2.3$, $p < 0.001$), and had statistically higher total charges with a median of \$46,023.00 (IQR = \$31,904.00–\$67,590.00, $p = 0.022$).

Categorical variables of nonsecretory tumor patients and secretory tumor patients were compared as depicted in ►Table 1. Patients with secretory tumors were statistically more often female ($p < 0.001$), younger ($p < 0.001$), privately insured ($p < 0.001$), white ($p < 0.001$), admitted to a teaching hospital ($p < 0.001$), and admitted in the west ($p < 0.001$). Patients with secreting tumors were also less likely to be admitted to a private for-profit hospital ($p < 0.001$).

The factors driving LOS and total charges were explored in multivariate analysis using a generalized linear model (►Fig. 1). Controlling for secretory versus nonsecretory tumors as well as CCI comorbidities did not significantly improve the generalized linear model and thus these variables were not included in the final model. Discharge to other than self-care was the largest contributing variable. These patients had a 74% increase in LOS (1.5 days) and 57% increase in total charges (\$9,090.47) in comparison to patients that were discharged to self-care. Other patient factors that drove both longer LOS and increase total charges were living in a metropolitan area, having a lower median income, Hispanic ethnicity, and having an increased amount of AHRQ comorbidity indices. The only factor that predicted both a shorter LOS and lower total charges was having private insurance. These patients had a shorter LOS and decreased charges by 7% (0.14 days, \$1,164.08) compared with those with Medicare or Medicaid.

Hospital factors were analyzed within the same generalized linear model (►Fig. 2). Private hospital status was the only factor that leads to both a longer LOS and increased total charges. Analysis showed that larger hospital size (rural > 100 beds, urban/nonteaching > 200 beds, and > 500 urban/teaching), and hospitals in the northeast and west (when compared with the Midwest) had shorter LOS but increased total charges. There were no hospital-specific characteristics that significantly decreased LOS while simultaneously lowering total charges.

Discussion

This study examined the effects of patient and hospital characteristics on LOS and total charges in uncomplicated patients undergoing TSA. We observed that when considered together, socioeconomic factors, such as urban domicile, household income, and insurance status, impact LOS and total hospital charges. These factors should be considered when coordinating the discharge process. While several socioeconomic factors significantly predict hospital LOS and charges, the discharge disposition ultimately has the greatest effect.

The typical postoperative TSA inpatient LOS lasted several days due to the need for serial neurological examinations, pain control, mobilization, assessment of pituitary function, surveillance for CSF leak, and electrolyte monitoring.^{3,15} It can be prolonged further with the use of postoperative lumbar drains, extended intensive care unit (ICU) stay, repeated blood draws to assess pituitary function, complications, and certain medical comorbidities.^{3,7,16–18} However, due to advancement in medical care and an increasing

emphasis on cost-effective health care, LOS for TSA has reportedly decreased by 4.6% per year from 1996 to 2000.⁴ Published works have shown that the current average hospital stay for TSA is 3 to 4 days.^{1,4,18} Our cohort had a similar LOS, averaging at 3.2 days, despite intentionally excluding patients with postoperative complications or pathologies that would typically necessitate prolonged LOS. Given the similarities between our LOS and those studies that included patients with medical complications, this suggests that socioeconomic factors can still significantly impact LOS independently from their medical comorbidities.

We did not find that secretory versus nonsecretory tumors had a significant impact on overall LOS or total charges in patients undergoing TSA. Interestingly, however, we did find that patients with secretory tumors were statistically more often privately insured, white, and admitted to a teaching hospital. The cause of this finding is unclear, but it is possible that secretory tumors tend to present with subtle symptoms, so while wealthy, privately insured patients are more likely to have an extensive work-up that leads to the proper diagnosis, and then are more likely to be referred to a large teaching hospital for a definitive surgical treatment. We suggest further research efforts could investigate this finding.

Of the hospital-specific factors, private hospitals were the only predictor of both a shorter LOS and decreased total charges. The NIS database classifies teaching hospitals as government owned (source). These teaching hospitals are typically academic centers that attract inherently more complicated patients, which may explain what we are seeing. We did exclude patients with the more common postoperative complications, but it is important to note that with these discharge-level databases, you cannot always account for the myriad of patients factors that impact each surgeon's clinical decision process for when a patient is safe to discharge.

The information presented in this article may be applicable to the cohort of patients that would be eligible for an early discharge. One study by Thomas et al implemented a care protocol focusing on patient education, early mobilization, and scheduled inpatient and outpatient endocrine assessments, allowing 92% of patients to be successfully discharged on postoperative day 1.³ There was no increase in hospital readmissions, however, implementation at other hospitals would require a close relationship between endocrinologists and surgical teams as well as dedicated support staff to adhere to the close outpatient monitoring and telephone interviews that are required.³ A similar study implemented a postoperative day 1 discharge protocol that included a detailed preoperative evaluation and review of medical and socioeconomic factors.¹⁹ It found only 60% of patients were able to be successfully discharged on postoperative day 1 with an average LOS at 1.5 days.¹⁹ It is important to note that this study used insurance status as a proxy for overall socioeconomic status and failed to take into account the myriad of other social factors that may impact LOS such as health literacy, support at home, and understanding of the procedure and postoperative follow-up.

Our study accounted for these additional social factors and ascertained that the 1st quartile of median income,

Table 1 Patient and hospital characteristics

Patient characteristics	Nonsecretory	Secretory	Total	<i>p</i>
Gender	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Female	2,502 (47)	722 (65.2)	3,224 (50.1)	< 0.001
Male	2,819 (53.0)	386 (34.8)	3,205 (49.9)	
Age group	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
80 and over	209 (3.9)	2 (0.2)	211 (3.3)	< 0.001
70–79	722 (13.5)	43 (3.9)	765 (11.8)	
60–69	1,195 (22.4)	123 (11.1)	1,318 (20.4)	
50–59	1,237 (23.3)	234 (21.1)	1,471 (22.8)	
40–48	960 (18.0)	240 (21.6)	1,200 (18.6)	
30–39	618 (11.6)	261 (23.5)	879 (13.6)	
18–29	405 (7.6)	208 (18.7)	613 (9.5)	
Race/Ethnicity	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
White	2,869 (60.1)	655 (68.2)	3,534 (61.5)	< 0.001
Black	859 (18.0)	93 (9.5)	952 (16.6)	
Hispanic	626 (13.1)	142 (14.6)	768 (13.4)	
Other	417 (8.7)	75 (7.7)	492 (8.6)	
Insurance	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Medicare/Medicaid	1,853 (34.8)	227 (20.5)	2,080 (32.3)	< 0.001
Private	2,991 (56.1)	789 (71.1)	3,780 (58.7)	
Other	784 (9.1)	94 (8.5)	581 (9.0)	
Discharge disposition	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Self-care	5,070 (94.8)	1,066 (95.9)	6,136 (95.0)	0.121
Other care	276 (5.2)	45 (4.1)	321 (5.0)	
AHRQ class	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
0	1,603 (30.0)	331 (29.8)	1,934 (30.0)	0.002
1	1,539 (28.8)	290 (26.1)	1,829 (28.3)	
2	1,226 (22.9)	238 (21.4)	1,464 (22.7)	
3	612 (11.4)	141 (12.7)	753 (11.7)	
≥ 4	366 (6.8)	111 (10.0)	477 (7.4)	
CCI class	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Low (< 3)	5,256 (98.3)	1,091 (98.2)	6,347 (98.3)	0.197
Medium (4–5)	66 (1.2)	19 (1.7)	85 (1.3)	
High (6–7)	21 (0.4)	1 (0.1)	22 (0.3)	
Very high (> 8)	3 (0.1)	0 (0)	3 (0.05)	
Domicile	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Not metro or micropolitan	244 (5.7)	53 (5.9)	297 (5.8)	0.902
Micropolitan	413 (9.7)	93 (10.4)	506 (9.8)	
Metro of 50k to 249k	373 (8.8)	84 (9.4)	457 (8.9)	
Metro of 250k to 999k	750 (17.7)	159 (17.8)	909 (17.7)	
Fringe metro 1 million	997 (23.5)	195 (21.8)	1,192 (23.2)	
Central metro 1 million	1,467 (34.6)	311 (34.7)	1,778 (34.6)	

Table 1 (Continued)

Patient characteristics	Nonsecretory	Secretory	Total	p
Median household income	n (%)	n (%)	n (%)	
1st quartile	1,245 (23.9)	237 (21.8)	1,482 (23.5)	0.172
2nd quartile	1,221 (23.4)	244 (22.4)	1,465 (23.3)	
3rd quartile	1,349 (25.9)	282 (25.9)	1,631 (25.9)	
4th quartile	1,397 (26.8)	324 (29.8)	1,721 (27.3)	
Hospital characteristics				
Teaching status	n (%)	n (%)	n (%)	
Teaching	2,741 (84.2)	637 (89.8)	3,378 (85.2)	< 0.001
Nonteaching	516 (15.8)	72 (10.2)	588 (14.8)	
Region	n (%)	n (%)	n (%)	
Midwest	2,013 (37.7)	339 (30.5)	2,352 (36.4)	<0.001
Northeast	1,014 (19.0)	215 (19.4)	1,229 (19.0)	
South	975 (18.2)	194 (17.5)	1,169 (18.1)	
West	1,344 (25.1)	363 (32.7)	1,707 (26.4)	
Location	n (%)	n (%)	n (%)	
Urban	3,183 (97.7)	700 (98.7)	3,883 (97.9)	0.091
Rural	74 (2.3)	9 (1.3)	83 (2.1)	
Hospital size	n (%)	n (%)	n (%)	
Small	424 (8.0)	135 (12.3)	559 (8.8)	< 0.001
Medium	662 (12.5)	111 (10.1)	773 (12.1)	
Large	4,197 (79.4)	855 (77.7)	5,052 (79.1)	
Ownership	n (%)	n (%)	n (%)	
Government, nonfederal	863 (16.3)	213 (19.3)	1,076 (16.9)	< 0.001
Private, nonprofit	3,991 (75.5)	841 (76.4)	4,832 (75.7)	
Private, investor owned	429 (8.1)	47 (4.3)	476 (7.5)	

Abbreviations: AHRQ, Agency for Healthcare Research and Quality; CCI, Charlson Comorbidity Index.

metropolitan domicile, and insurance status were the most predictive of LOS. Although there has been only one study examining the effects of socioeconomic factors on LOS in patients undergoing TSA, there have been several studies in other patient populations examining how these socioeconomic factors influence LOS.^{10,20–30} These studies were conducted among patients who were in both the medical or surgical wards,^{20–22,25–30} only within the general medicine service^{23,24} or were primarily surgical.¹⁰ Household income has been cited as a predictor of decreased LOS by a few studies;^{29,30} however, when investigating domicile and insurance status, there have been conflicting results.^{10,21,22,24,25,28,29} While some support urban domicile as a predictor of longer LOS, others did not find any statistically significant relationship between the two.^{24,25,29} With respect to our finding that insurance payer is predictive of LOS, two prior studies support payment method as a predictor of a LOS.^{21,22} However, these were analyzed using regression models which are unable to tell the direction in which payment method influences LOS. In contrast to some previous studies,^{25,28} when we compared patients with

Medicaid or Medicare to patients with private insurance, the patients that were privately insured had shorter LOS and patients without insurance had increased LOS. This could be explained by the fact that those patients with Medicare or Medicaid may have more medical comorbidities than their insured counterparts. This expansion is further supported by our observation that an increased amount of AHRQ comorbidity indices correlated with an increased LOS.

While several socioeconomic factors significantly drive LOS and total hospital charges, the discharge disposition ultimately had the greatest influence. This is consistent with other observations in that organization factors, like hospital coordination with discharge facilities, were the most important predictors of delayed discharge.^{20,26,27} This suggests that efforts should focus on improving organizational factors such as coordination with social work and outside facilities to decrease LOS and charges for this patient population. Nonetheless, factors such as median income, domicile, and insurance status still significantly impact patient LOS and total charges. Future studies should include these when implementing early discharge protocols.

Fig. 1 Patient-specific characteristics contributing to hospital length of stay (LOS) and total charges.

Fig. 2 Hospital-specific characteristics contributing to hospital length of stay (LOS) and total charges.

This study is not without limitations. Chiefly, it is a retrospective analysis of a large administrative database. These large administrative databases have inherent issues such as limited clinical information available and potential coding errors. Thus, caution must be taken when drawing conclusions from these types of databases. Although we assume it to be accurate and we can aim to draw these conclusions, it is near impossible to determine the accuracy. Furthermore, the lack of clinical data upon admission (e.g., tumor size and surgical history) limits the ability to control the analysis across a wide variety of patient and disease-

specific variables. Further differentiation of the transsphe-noidal approach into endoscopic versus microscopic groups was not possible in this cohort due to coding generalities thus we are not able to determine if the type of approach affects LOS. Additionally, the ability to accurately capture postsurgical adverse events is limited in an administrative database, as some complications may have been present on admission and represent surgical indications rather than a true postoperative adverse event. The strength of the study is the large number of included patients and the ability to study medical practice at large without selection bias.

Conclusion

There are a myriad of factors that influence discharge timeline and status following TSA. Discharge disposition had the greatest impact on the ability to discharge patients in a timely manner and decrease their total hospital charges. Even among those patients with uncomplicated TSA, patients can be delayed in their discharge due to socioeconomic factors, such as domicile, household income, and insurance status. Future efforts will focus on identifying patient-centered risk factors that may impact LOS and associated charges. Once patients are identified as high risk, these factors can be mitigated with the coordination of social work. This process, along with controlling for medical complications, can be implemented into early discharge protocols in this patient population.

Conflict of Interest

None.

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